Building a Better ALD - use of Plasma Enhanced ALD to Construct Efficient Interference Filters for the FUV

Completed Technology Project (2016 - 2018)

Project Introduction

Over the past few years the advent of atomic layer deposition (ALD) technology has opened new capabilities to the field of coatings deposition for use in optical elements. At the same time, there have been major advances in both optical designs and detector technologies that can provide orders of magnitude improvement in throughput in the far ultraviolet (FUV) and near ultraviolet (NUV) passbands. Recent review work has shown that a veritable revolution is about to happen in astronomical diagnostic work for targets ranging from protostellar and protoplanetary systems, to the intergalactic medium that feeds gas supplies for galactic star formation, to the most distant of objects in the early universe. These diagnostics are rooted in access to a forest of emission and absorption lines in the ultraviolet (UV)], and all that prevents this advance is the lack of throughput in such systems, even in space-based conditions. We propose to use a range of materials to implement stable optical layers suitable for protective overcoats with high UV reflectivity and unprecedented uniformity, and use that capability to leverage innovative ultraviolet/optical filter construction to enable the type of science described above. The materials we will use include aluminum oxide and hafnium oxide (as an intermediary step for development only) and progressing to a range of fluoride-based compounds (for production). These materials will be deposited in a multilayer format over a metal base to produce a stable construct. Specifically, we will employ the use of PEALD (plasma-enhanced atomic layer deposition) methods for the deposition and construction of reflective layers that can be used to construct unprecedented filter designs for use in the ultraviolet. Our designs indicate that by using PEALD, we can further reduce adsorption and scattering in the optical films as a result of the lower concentration of impurities and increased control over the stoichiometry to produce vastly superior quality and performance over comparable traditional thermal ALD techniques currently being developed by other NASA-funded groups.

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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Strategic Astrophysics Technology

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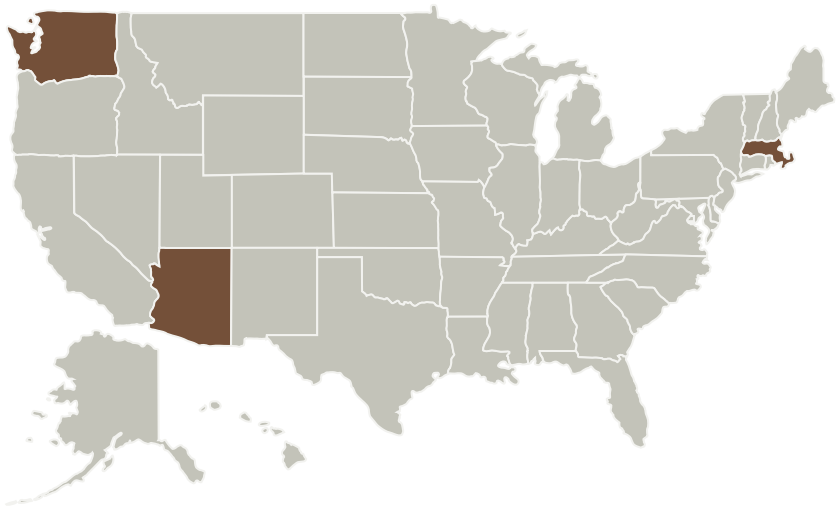
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Arizona State University-Tempe(ASU)	Supporting Organization	Academia Alaska Native and Native Hawaiian Serving Institutions (ANNH)	Tempe, Arizona

Primary U.S. Work Locations	
Arizona	Massachusetts
Washington	

Project Management

Program Director:

Mario R Perez

Program Manager:

Mario R Perez

Principal Investigator:

Paul A Scowen

Co-Investigators:

Robert Nemanich
Eric M Moreno
Brianna S Eller
Franz A Koeck
Matthew Beasley
Tom Mooney
Hongbin Yu

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Target Destination

Outside the Solar System